THE EXPLOSIVES ENGINEER

Forerunner of Progress in Mining, Quarrying, Construction

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Views and opinions expressed by the authors of articles in this publication are their own, and they do not necessarily represent those of the publisher.

Nevada's Steptoe Valley in White Pine County is one of the world's major copper-production areas. Prospecting and probing for pay ore have been going on here since 1868, when the old Robinson Mining District was organized. Big-scale open-pit mining was pioneered in the Valley, along with the famed Bingham Canyon operation in Utah. Today, it is the locale of the mining and milling operations of the Nevada Mines Division of Kennecott Copper Corporation.

Kennecott's mining properties lie about 7 to 8 miles west of Ely, Nevada. Operations are carried on in three open pits – the Liberty, the Veteran, and the Kimbley. An underground section, called Deep Ruth, is being developed for mining on three levels, with two shafts. A production schedule of 8,000 tons of copper-bearing ore is projected for Deep Ruth, with the production target date set for the middle of 1957.

Production of copper-bearing ore in the Liberty pit began in 1908. Today, it is truly a monumental mining operation extending 650 to 700 ft. below the surface, one mile long, and ⅝ of a mile wide. Working on benches 50 ft. high, the miners average a daily production of 7,300 tons of ore and 5,069 tons of waste.

The Veteran pit, farthest west in the Ely area, produced its first copper-bearing ore in 1908. Originally an underground operation under various ownerships, the Veteran went into open-pit production in 1955. When fully developed, it will be 2,450 ft. long, 1,500 ft. wide, and about 850 ft. from the highest point to the bottom. Its life expectancy is 10 to 12 years.

Stripping operations at the Kimbley pit began in November, 1950. Estimates indicate the orebody will be exhausted by November of this year. In the last months of 1955, it was producing ore at a rate of 4,200 tons a day.

All of the copper-bearing ores from Kennecott's mining operations in the area are milled at the company's plant at McGill, Nevada.

In a comprehensive article beginning on page 70, Lewis Nordyke presents detailed descriptions of the mining and milling operations of Kennecott's Nevada Mines Division in the Steptoe Valley of Nevada.

* * *

The construction of a new bridge across the Connecticut River at State Street in Hartford, Connecticut, required the installation of concrete foundations in rock under 20 ft. of water.

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For more details on the unusual equipment and techniques employed, including the drilling and blasting procedures, please turn to the article on page 88.

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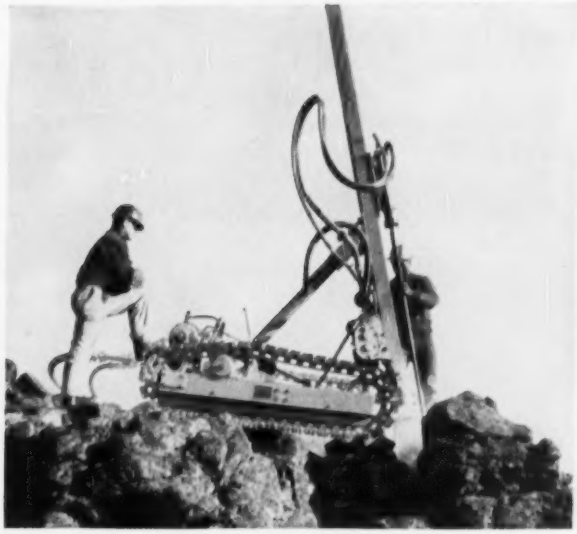

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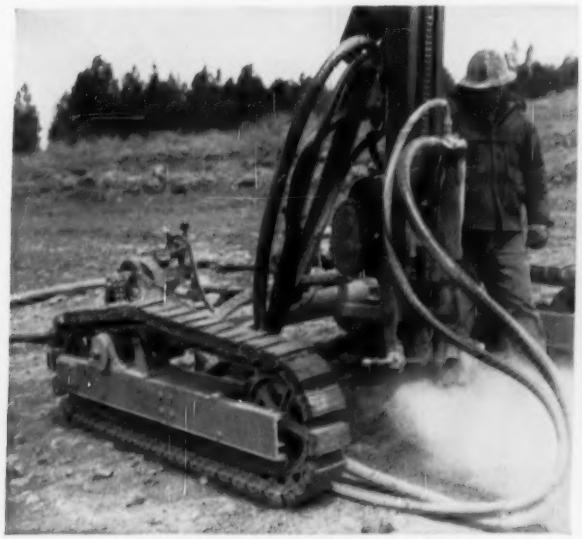

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John Charles Kinnear, Jr.

GENERAL MANAGER

NEVADA MINES DIVISION

KENNECOTT COPPER CORPORATION

A Biography

THE career of John Charles Kinnear, Jr., general manager of the Nevada Mines Division of Kennecott Copper Corporation, is an example of the success that comes from early devotion to a chosen field, sound training in the fundamentals, and the energetic application of natural ability and resourcefulness in the chosen field.

John, as his friends and associates know him, was born in McGill, Nevada, November 2, 1914, the son of John Charles and Bertha (Clark) Kinnear. At that time, his father was general manager of Nevada Consolidated Copper Mining Company, the predecessor of the Nevada Mines Division of Kennecott Copper Corporation. Later, J. C. Kinnear, Sr., was made a vice president of Kennecott and continued in that position until his retirement in December, 1951.

John received his elementary education at the public school in McGill and the White Pine County High School in Ely, Nevada. After graduating from high school, he enrolled at Pomona College in Claremont, California, and was graduated in 1936 with a B.A. degree. At Pomona, sports were an integral part of his career: he was a three-letter varsity man in basketball and football, and captain of the football team in his senior year. Other extracurricular activities included the presidency of Sigma Tau fraternity and of the Associated Men Students.

Following his graduation from Pomona College, John matriculated at Massachusetts Institute of Technology in Cambridge, his father's alma mater. Two years later, he was graduated with a B.S. degree in metallurgy. At M.I.T., John participated in intramural football, basketball, and baseball contests. He also was a member of Sigma Tau Chapter of Delta Kappa Epsilon fraternity, and a student member of American Institute of Mining, Metallurgical and Petroleum Engineers.

During summer vacations from high school and college, John worked in a wide variety of jobs: cowpuncher, hayhand, laborer, survey rodman, and in a concrete-mixing gang. After graduating from M.I.T., he went to work as a laborer in the bullgang at the reconstructed smelter of Kennecott Copper Corporation in McGill. After a few weeks, he was transferred to the Test Laboratory as a helper, and, later, to the smelter as an engineer.

In March, 1939, he was transferred to the Chino Mines Division of Kennecott at Hurley, New Mexico, as smelter engineer. Nine years later, he was brought back to McGill to become the assistant to the general manager of the Nevada Mines Division. After a year and a half, he was made assistant general manager, and, on October 1, 1950, was promoted to general manager of the division, the position he holds today.

John Kinnear is a director of the Nevada Bank of Commerce, a part owner of the Laucirica Livestock Company, a 32nd-degree Mason and a member of the Shrine, and active in the Boy Scouts of America. Last year he was chairman of the Nevada Area Council Sustaining Membership in the Boy Scouts, also a Council member and chairman of its White Pine District. Interested in accredited higher education in the State of Nevada, he was a candidate for the board of regents of the University of Nevada in the 1952 general election.

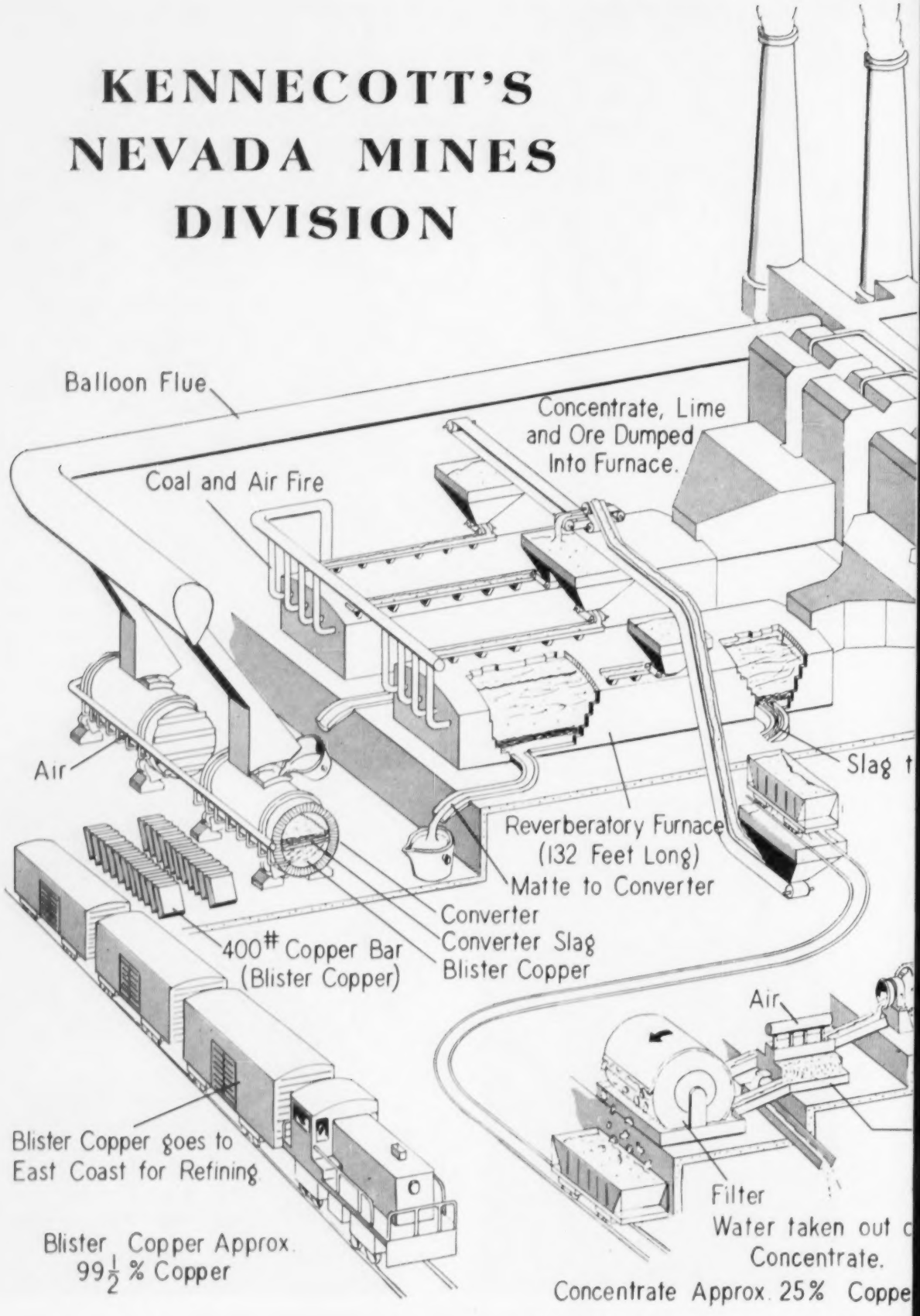
Mr. Kinnear is prominently identified with several professional societies: a member and former chairman of the Nevada Section of the American Institute of Mining, Metallurgical and Petroleum Engineers; past chairman of the Papers and Program Committee of its Extractive Metallurgy Division; and current chairman of the Extractive Metallurgy Division. He has served on the board of governors of the American Mining Congress, on its program committee, and as a speaker at conventions. He is a past president and a director of the Nevada Mining Association, a member of the Governor of Nevada's Advisory Mining Committee, and of the Mining and Metallurgical Society of America.

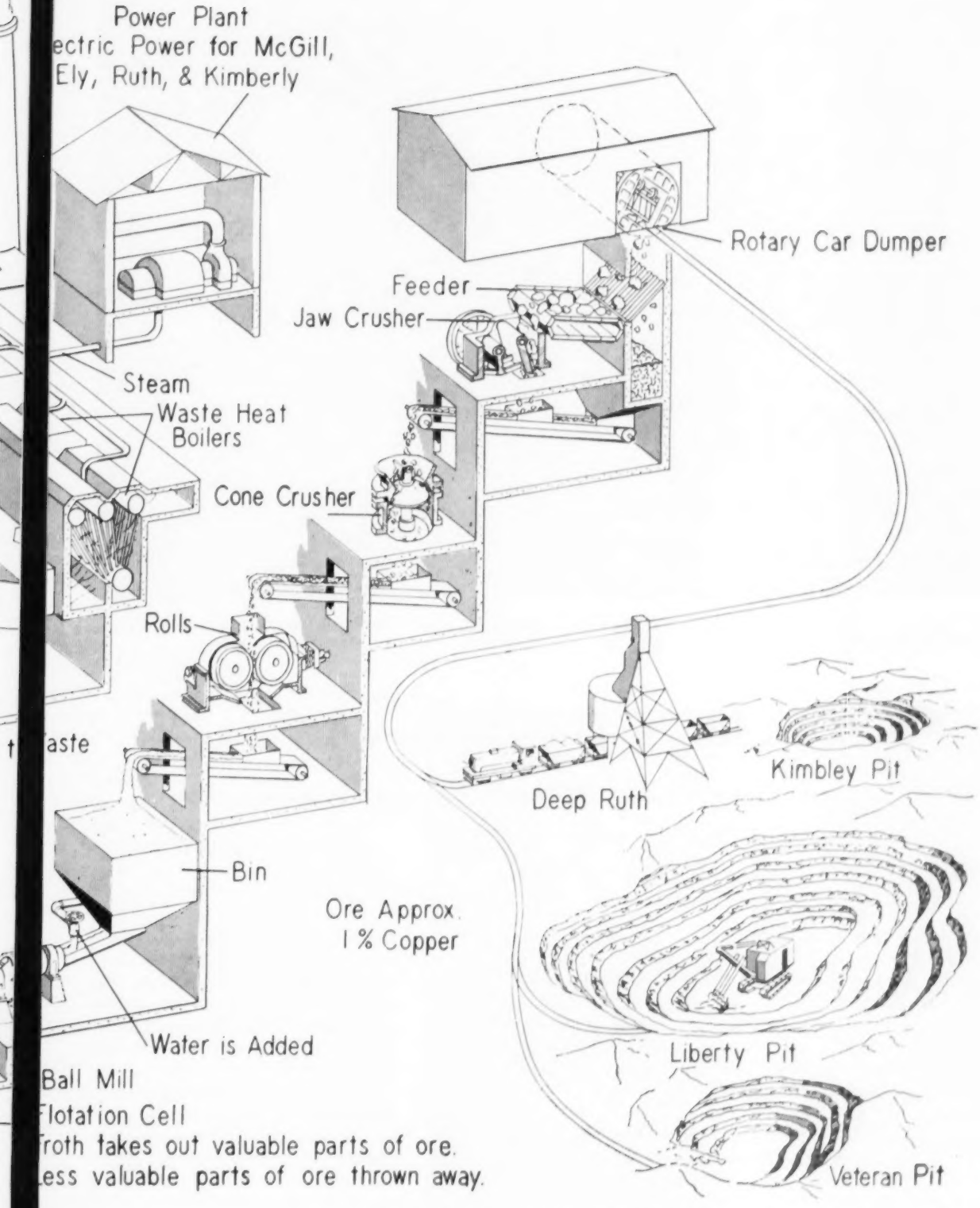
John Charles Kinnear, Jr., married Helen Poor on July 22, 1939, in Peabody, Massachusetts. They have two daughters, Marcia and Sheila, and one son, John. The family home is in McGill, Nevada.

John's early participation and continued interest in athletic contests make sports his No. 1 hobby. His most recent interest is skiing. He also raises and rides quarterhorses, and, when opportunity permits, hunts both rifle and shotgun game. On the less strenuous side, he enjoys experimenting in the family kitchen and outdoor grill as an amateur chef.

JOHN CHARLES KINNEAR, JR.

KENNECOTT'S NEVADA MINES DIVISION





A SIMPLIFIED DRAWING OF THE OVERALL OPERATION

LIBERTY PIT: This monumental open-pit operation, with its rows of 50-ft.-high working benches extending 700 ft. below the surface, is one mile long and ⅝ of a mile wide. As of late 1955, a total of 337,000,000 tons of ore and waste had been mined here.

Kennecott's Nevada Mines Division maintains a daily production schedule approximating 12,000 tons of copper-bearing ores

LEWIS NORDYKE*

THE United Airlines Convair flying eastward from Reno, Nevada, hovered over the Steptoe Valley in White Pine County. It was making its approach for a landing at the town of Ely in the eastern part of the state. Speaking over the intercom, the pilot informed his passengers of some of the wonders of the valley.

"This is copper country," he said, "home of the famed Liberty pit. If you'll look out on your right you can see the Veteran and other pits. You'll also see the headframe of an underground mine. This is one of the historic mining regions of Nevada."

As the plane banked, the passengers could see at a glance one of the world's major copper-production areas. In one 20-mile stretch of the valley, they could see four bustling towns: McGill; Ely, the county seat; Ruth; and Kimberly. They could see the old Copper Flat, now known as Liberty pit, and four other open pits from which low-content ore is blasted and excavated. From the air the deepening Liberty pit looked like pictures of Mesa Verde, the renowned home of ancient cliff dwellers in Colorado.

The pilot was correct about the historic features of the region. Prospecting and probing for pay ore have been going on here since 1868, when the old Robinson Mining District was organized. Big-scale open-pit mining was pioneered here, along with the famed Bingham Canyon operation in Utah.

The visitor to Steptoe Valley can easily bump into a bit of confusion. One of the towns is named Kimberly and one of the pits is known as Kimbley; they are not related. There is an Old Ruth and a New Ruth, and, also, a lady named Ruth who can never fib about her age. The Old Ruth mining claim was named for her when she was a baby. Later, the town of Ruth was

*2809 Lipscomb Street
Amarillo, Texas

named for the claim and so was the copper mine. The Old Ruth mine played out some years ago, but two bodies of ore were found in the innards of the vicinity and a new Ruth mine (known as Deep Ruth) is being developed for mining by block caving. Because the original town of Ruth was over the area to be caved by the Deep Ruth, the larger part of it was moved – lock, stock, and barrel – to a safer location and is now known as New Ruth. Meanwhile, Mrs. Ruth Marcotte, who was little Ruth McDonald when her dad, D. C. McDonald, named the mining claim for her, still lives in Ely, which is very close to Old Ruth and New Ruth. The lady never misrepresents her age.

The Nevada Mines Division

The Nevada Mines Division of Kennecott Copper Corporation consists of three open pits and an underground section. The Liberty, the Veteran, and the Kimbley are operated as open pits and Kennecott is developing the Deep Ruth underground section for early production. The Kennecott concentrator and smelter are at McGill. Because of overlapping claims, Consolidated Coppermines Corporation is a 24 per cent partner with Kennecott in the west end of the Liberty pit and a 20 per cent partner in the Veteran pit. Kennecott mines and mills the ore. Consolidated Coppermines operates one pit in the area, the Tripp. The ore produced is processed at Kennecott's McGill plant.

This article is limited to the operations of Kennecott in and around the towns of Ely, Ruth, McGill, and Kimberley. A later story in THE EXPLOSIVES ENGINEER will be devoted to the activities of the Consolidated Coppermines Corporation in this area.

The Kennecott mines lie about 7 to 8 miles west of Ely in the more mountainous portions of ranges that have a northerly-southerly trend. The elevation at the surface averages 7,000 to 7,400 ft. The orebodies have an easterly-westerly trend which cuts across the range of a slight curve, starting at what is known as Lane City. The copper deposits are localized in a zone about 1 mile wide and 5 miles long. Several rock types, including limestone, sandstone, shale, monzonite porphyry, and rhyolite, are exposed to the surface. Jasperoid, consisting mainly of quartz which was deposited in matasomatic replacement of limestone, is the hardest formation in the mining sections in the area.

DRILLING BLAST HOLES: One of the drills at work putting down holes for blasting on a new bench in the Liberty pit. The blast holes, drilled with electrically powered churn drills, are 9 in. in diameter, with an average depth of 57 ft., spaced on 20-ft. centers.

RECOVERING THE ORE: Blasted material is excavated with 4½-cu. yd. electric shovels and loaded into 75-ton ore cars. Trains of loaded cars are pulled out of the pit by diesel-electric locomotives. The Liberty is the only pit in the area with rail haulage.

RAIL TRANSPORTATION: A train of waste material, upper left, is en route to the disposal area. In the foreground, the pit crane is on hand in case a car should be derailed or overturned. The pit equipment includes five 1,500-hp. and six 600-hp. diesel-electric locomotives.

The Copper-Bearing Minerals

In the Liberty pit, the copper-bearing mineral is chalcopyrite, occurring in silicified and garnetized limestone, and porphyry. In the Veteran pit, copper occurs in both altered limestones and porphyry as carbonates and sulphides. In the Kimbley pit, the principal mineral is chalcocite with some chalcopyrite occurring in highly silicified porphyry.

Except for some notable differences, mainly in haulage, the methods of stripping and ore recovery in the three open pits are essentially the same. Being an old and awesome hole, with rail haulage shelves much like a circular staircase of a spiral classifier, the Liberty is the granddaddy of the pits in the Ely vicinity. The Nevada Mines Division really was born with the Liberty.

Stripping of the overburden started in 1907 and the first ore was produced in 1908. This operation was done by Cumberland-Ely Copper Company, which, on August 31, 1910, became the Nevada Consolidated Copper Corporation, a Kennecott property, and operated under that name until January 1, 1943, when it became known as Nevada Mines Division. The Ruth mine and the plant at McGill were included in this chain of ownership.

The Liberty Pit

The Liberty pit, with its walls dazzling in the sun, is a monumental mining operation. At first, the pit was a good-sized hump of a hill; it is now 650 to 700 ft. below the surface, a mile long, and ⅝ of a mile wide. As of late 1955, 138,000,000 tons of ore had been mined there; with it came 199,000,000 tons of waste. Around three billion pounds of blister copper have come from this pit. During the year 1955, daily production averaged 7,300 tons of ore and 5,069 tons of waste. The ore in this and other pits is about 1 per cent copper or less.

Mining in the Liberty is on benches 50 ft. high. The berms are 40 ft. Vertical blast holes 9 in. in diameter, averaging 57 ft. deep and spaced on 20-ft. centers, are drilled with electrically powered churn drills equipped with 6-ft. California pattern bits. The pattern for the drill holes depends on the hardness of the material to be blasted. From one to 12 or more holes are fired at a time; the average is seven to eight.

WASTE DISPOSAL: Waste material from the Liberty pit is deposited onto a disposal area from side-dump cars. In the pit operations, waste is separated from mill-grade ore by selective mining.

Quite a bit of springing is done in these deep holes. Frank Quilici, the pit superintendent, says this procedure is more on the order of chambering than springing. From 25 to 30 cartridges of Hercules Gelamite® 1, size 1½ by 5 in., are loaded into the bottom of a hole and the charge is detonated by electric blasting caps. This results in enlarging the bottom of the hole so that it will take a more concentrated charge of explosives. One and two 23G containers of Gelamite 1, 6 in. by 25 lb., are used as the primer. After the holes are sprung, or chambered, they are loaded with Tritex* in 8-in. by 50-lb. polyethylene tubes. In the case of wet holes, Hercomite® bag powder is used for the main charge.

All the explosives are not concentrated in the chamber; two-thirds of the main charge extends above the chamber. None of the holes are loaded until four hours after the chambering details are completed. Holes are loaded on a ratio of 0.36 lb. of explosives per cubic yard of material in the solid. The charges are stemmed with pit material, which is supplied by

*Hercules Powder Company Trademark

VETERAN PIT: At the Veteran pit, the stripping of overburden began in October, 1953. Within three months, the stripping contractor, Isbell Construction Company, blasted and excavated 4,000,000 tons of waste material.

CHURN DRILLING: Operations in the Veteran pit are conducted on benches with working faces 50 ft. and 25 ft. high. Holes are drilled by electric churn drills to a depth of 57 ft. and 32 ft., respectively. Last December, daily production was 34,132 tons of ore and waste.

AFTER A BLAST: After a blast in the Veteran pit, a 4½-cu. yd. full-revolving electric shovel loads the broken ore into end-dump trucks which deliver to a tipple for unloading into rail cars.

Scoopmobile and dump truck. From 25 to 30 ft. of stemming is tamped into each hole.

Blasting

The charges in primary blasts of the 9-in.-diameter holes are detonated with Primacord** (Reinforced Primacord down each hole to the primer cartridge) and short-period delay electric blasting caps.

Drilling holes for blasting in the toe, or bottom, of a bench is done with a 4-in. Leyner drifter mounted on a tractor. It is equipped with 1½-in.-round hollow Leyner steel and detachable bits. Air is supplied by a two-stage air-cooled compressor mounted on the tractor. The holes are loaded with Gelamite 1 in 1¼ by 8-in. cartridges. Blasts are detonated in the same manner as described previously.

In the porphyry, secondary blasting is negligible. In the hard garnetized limestone, blasting produces a good many boulders. These are shoveled to the sides of the blast area, drilled with jackhammers, and blasted with small charges of dynamite. These charges are detonated with electric blasting caps. A compressor mounted on a four-wheel-drive truck supplies air for jackhammer drilling.

Excavating

Blasted material is excavated with 4- and 4½-cu. yd. full-revolving electric shovels (five of them in the pit) and loaded into railway cars. The Liberty is the only pit in the area with rail haulage. There is some double trackage. The winding haul out of the pit with ore is 4¾ miles, never on a grade greater than 2 per cent. Waste haulage is 5¾ miles. Total trackage in the pit is about 15 miles. Trackage is shifted frequently to place the cars closer to the blasted benches. A rail crew is on the job all the time. The pit is equipped with a mechanic's railway car — a shop on the rails. An 80-ton Industrial hoist is on hand in case of a derailment or an overturned car.

The ore cars are 75-ton capacity. The pit has five 1,500-hp. and six 600-hp. diesel-electric locomotives. The larger locomotives haul out the ore and the waste; the smaller ones are used largely for car spotting. Ore trains

**Reg. U.S. Pat. Off. by The Ensign-Bickford Company

averaging eight cars are pulled out of the pit to the staging area, where 30-car trains are assembled for the 23-mile trip over the Nevada Northern Railway, which is owned by Kennecott, to the concentrator at McGill.

Other equipment in the Liberty pit includes tractors with dozers, a water truck, supply truck, mechanic's truck, three pick-up trucks for personnel, a powder truck, and a four-wheel-drive utility truck.

The operating methods and equipment used in the other two pits are essentially the same as in the old Liberty, with the exception that the Veteran and the Kimbley have truck haulage.

The Veteran Pit

The Veteran pit, farthest west in the Ely area, has a history almost as colorful as that of the Liberty – not as an open pit but as a producer of copper. In 1905, a group of claims called the Veteran was first developed by the Veteran-Ely Copper Company with the driving of the Paul tunnel. Work in the tunnel exposed a large area of mineralized but unpromising ground. The following year, the Cumberland-Ely Copper Company took over and a shaft was sunk which revealed a body of copper ore. In 1907, the ore was blocked out, a working shaft developed, and the first ore came out the following year. In 1909, a miners' strike closed the works for two years. Mining was resumed in 1911 under the ownership of the Nevada Consolidated Copper Company.

Operations continued until November, 1914. By that time, the 535-ft. Veteran shaft had been completed, the Paul tunnel had been driven 2,558 ft., and there were 16,000 ft. of other drifts. Ore production amounted to 641,149 tons, which yielded 34,500,000 lb. of copper.

Huge Stripping Operation

Kennecott's decision to operate these claims was based on a long-time study. The corporation had developed interesting information by churn drilling from 1907 to 1913. Further drilling in 1942-43 convinced Kennecott that the orebody below the surface was recoverable. Underground mining was considered by company officials but the decision was against it.

STRIPPING OVERBURDEN: Another view of the Veteran pit with one of the Isbell company's trucks en route to the disposal area with a load of overburden material from the stripping operations.

KIMBLEY PIT: Isbell Construction Company is under contract to strip the overburden and mine the ore at the Kimbley pit as long as the ore lasts. In late 1955, the pit was producing ore at the rate of 4,200 tons a day.

RELATIVELY SMALL AREA: Isbell crews began stripping the overburden at the Kimbley pit in November, 1950. The area covered by this pit is relatively small. Estimates indicate that the orebody at this location will soon be exhausted.

Further development in 1951 and 1952 and an agreement with Consolidated Coppermines to mine adjoining orebodies together resulted in the joint Veteran project. Because much of the ore was relatively close to the surface, Kennecott decided to mine by open-pit methods.

Stripping of overburden was started in October, 1953. In the last three months of that year, Isbell Construction Company of Reno, one of the major stripping contractors in the West, blasted and excavated 4,000,000 tons of waste. Ore production started in 1955, when Kennecott took over. Isbell removed 16,660,836 tons of waste. During the month of December, the Veteran pit was producing 1,132 tons of ore and 33,000 tons of waste each operating day. When it is completely developed, it will be 2,450 ft. long, 1,500 ft. wide, and about 850 ft. from the highest point on the rim to the ultimate bottom. It is estimated to last 10 to 12 years.

The Veteran pit has both 50-ft. and 25-ft. benches, and holes for blasting are drilled 57 ft. and 32 ft. deep. The principal equipment includes two electric churn drills; one rotary drill, diesel-powered; one full-revolving shovel, 4½-cu. yd. capacity; one full-revolving shovel with a 6-cu. yd. dipper (one smaller type shovel to be added in the near future); four trailed load 35-ton haulage units; and eight 35-ton conventional trucks with dual rear tires, with six more hauling units to be added.

The shovels load into the end-dump trucks. Waste is hauled to the spoil

area and dumped. The ore is hauled to a tipple and unloaded into rail cars. A shovel loader switches the cars in the loading area; it is equipped with a bucket for cleaning up spillage. Early in 1956, machine and repair shops were being constructed at the pit; they include wash racks, garage, welding works, battery charging, and tire-repair facilities.

The Kimbley Pit

Stripping at the Kimberly pit, comprising a comparatively small area, started in November, 1950, and the orebody there is calculated to be exhausted by November, 1956. In the last months of 1955, it was producing at the rate of 4,200 tons of ore a day. Isbell Construction Company stripped this pit and also removed the ore. This company is under contract to mine the pit as long as the ore lasts, with Ted Maestretti in charge of operations.

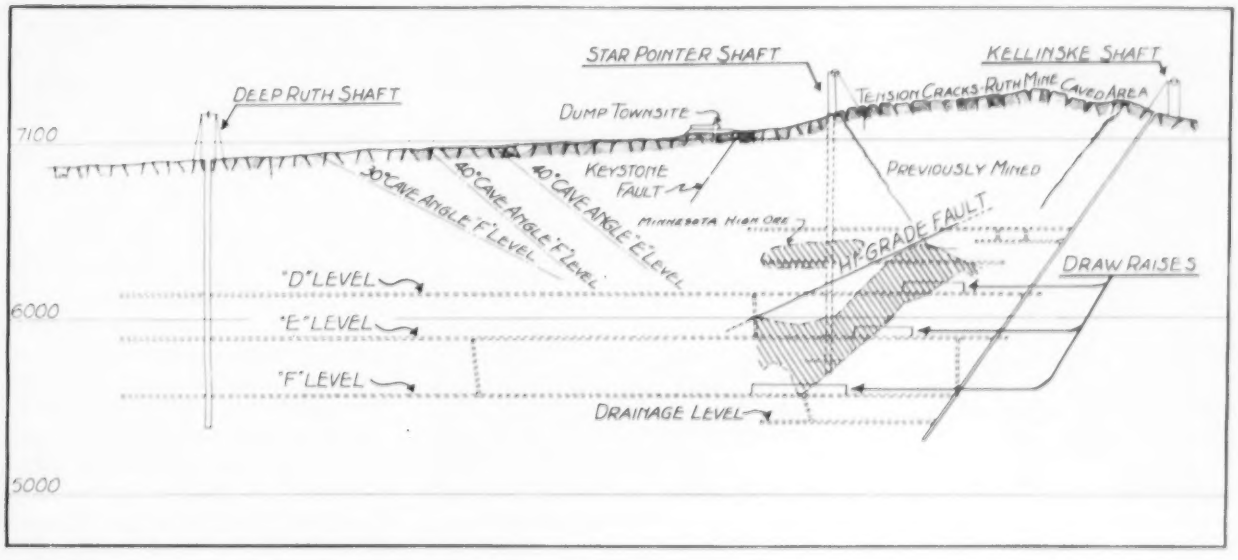
However, the winding up of activities at the Kimbley pit will not affect Kennecott's copper production in the area; there's the Deep Ruth underground section.

ROADWAY AT KIMBLEY: A truck loaded with ore moves up a steep, curving incline on its way out of the Kimbley pit. Ore from this pit is trucked to railroad cars for transportation to the smelter at McGill.

The Ruth Mine

This shaft has been a problem lately but a solution has been worked out. Though not quite as renowned as the Liberty pit of Copper Flat fame, the old Ruth mine is the oldest present operation in Nevada's Steptoe Valley.

On a day in 1900, Dave Bartley and Edwin F. Gray, miners from California, breezed into Ely flat broke. Instead of rustling work, as they had planned, they took a look at claims belonging to D. C. McDonald. These included the Ruth (namesake of Mc-



DEEP RUTH MINE: The shafts — Deep Ruth, Star Pointer, and Kellinske — are joined by a drift. The previously mined area and the tension cracks from the former caved section are indicated in the above drawing.

MINE HEADFRAME: The headframe above the Deep Ruth mine is 155 ft. high. The new hoist house is at left. The workings underground are being developed by Kennecott for mining by the block-caving method.

Donald's baby daughter) and the Kearsarge.

Dreaming of gold and silver, Bartley and Gray found financial backing and took a lease of the claims, with option to buy, for $3,500. They found a lot of copper, but the ore wasn't rich enough to pay for producing and hauling it 150 miles up the Steptoe to the nearest rail line. In 1902, Mark L. Requa appeared on the scene. After a close examination of the Bartley-Gray property, Requa paid $150,000 for it. This transaction laid the groundwork for the establishment of Nevada Consolidated Copper. In 1903, the company borrowed $2,000,000 to build a railroad from the mine to Cobre on the Southern Pacific, to develop the Ruth property, and build a mill, powerhouse, and smelter. This was the start of the Nevada Northern Railway, over which the first train rolled into Ely on September 6, 1906. The mill and smelter were built on property bought from W. N. McGill, a rancher, and that's how the town of McGill was located and named.

From the time of this early development until 1948, when operations ceased, the Ruth mine produced 19,000,000 tons of porphyry ore through the Star Pointer shaft. Long before Ruth production played out, the company was prospecting – churn and diamond drilling inside the mine and from the surface. This paid off in the finding of a porphyry orebody estimated to contain 25,000,000 tons averaging 0.83 per cent copper, from which 352,000,000 lb. of recoverable copper are expected. This is a downward extension of the old Ruth orebody. The decision to block cave that ore was made in mid-1951, and the production date was set for the end of 1953.

Then Ruth acted up. In sinking the Deep Ruth shaft, Foley Brothers of Pleasantville, New York, tapped an ocean of water which caused a long delay. The production target date was set for the second quarter of 1955. This has been shoved up to the middle of 1957. This later delay resulted from a piece of good luck. An orebody containing 1,300,000 tons of 1.18 per cent copper was found within the cave limits of the larger orebody and 500 ft. above the first production level, necessitating first mining. This new body is known as the Minnesota Hi-Ore. Immediate plans were made to mine this ore from a drift driven from the Star Pointer

shaft connecting with the Queen Raise (a former ventilation raise) with block caving, using branch raises, slusher drifts, and a combination of the two methods.

The previous operations in the Ruth mine had caused a considerable caved area with final cracks developing extremely close to the Star Pointer shaft. Additional mining would have destroyed the shaft. Because the town of Ruth was over the cave limits of the new operation, the village, which was owned by Kennecott, was moved a mile north of the new Deep Ruth shaft.

Mining on Three Levels

The Deep Ruth will be mined on three levels, D, E, and F, with two shafts: the water-troubled Deep Ruth vertical which will be 1,572 ft. deep; and the Kellinske shaft, a 55-degree incline which will be 2,245 ft. deep. The Kellinske, currently used for development of the main connecting drift to the Deep Ruth shaft, will eventually be a ventilation and emergency exit shaft. The shafts are 5,000 ft. apart. They will be connected with a drift on each level.

The drift on the D level was completed March 24, 1955. While development work continued there and on the E and F levels, production started in the Minnesota Hi-Ore. Mining out this body was calculated to take 16 months — up to the spring of 1957 .

In one way, mining in the Minnesota Hi-Ore is a make-ready for the future larger operations in Deep Ruth. Air for drilling and for auxiliary uses is supplied by compressors of 14,000-c.f.m. capacity.

Blasting

For the Minnesota Hi-Ore slusher-type caving, the headings are drilled in a V-cut pattern. The holes are 1⅝ in. in diameter and 6 ft. deep, with number of holes varying — usually 35 holes to a round. In blasting in this mine where water and soft formations are problems, wet holes are loaded with 40 per cent Gelatin Extra in 1⅛ by 8-in. cartridges. Dry holes are loaded with Gelamite 3-X in the same cartridge size. Blasts are fired electrically.

The V-cut in the raises consists of 10 to 20 holes 1⅝ in. in diameter and 4 ft. deep. They are loaded and fired

KELLINSKE SHAFT: The Kellinske shaft, a 55-degree incline opening, has been used for development of the main connecting drift to the Deep Ruth shaft. Later, this shaft will be used for ventilation and as an emergency exit.

in the same manner as in the headings. This same blasting method is used in 8-hole rounds in the fingers, with the holes 1¾ in. in diameter and 5 ft. deep. In drilling the undercut, the average round consists of 60 holes, each 6 ft. deep, or 120 holes to a square set. These jackleg and stoper holes are 1¾ in. in diameter. Primary blasting produces the results desired, and very little secondary blasting is required.

Some formations are too soft to blast and too hard to dig with a power shovel. In these situations, pneumatic claydiggers are used.

In the slusher operations, blasted material caves into slusher drifts. Tugger hoists, 25-hp. and 20-hp., pull the ore to the draw hole from where it spills into mine cars spotted directly below in the haulage drifts.

Yieldable circular steel sets are being used in the slusher drifts in the Minnesota Hi-Ore instead of timber. This is mainly an experiment to determine whether the sets can stand the gaff of caving pressure. If they stand up, similar sets will go in the slusher drifts planned for Deep Ruth. However, branch raises will be the principal method in that mine. These slusher drift circular sets are 8 ft. in diameter. There are tracks on the floor of the slusher drifts, and the tugger hoists scrape on these.

Hoisting

Ore from the Minnesota Hi-Ore is hoisted out at the Star Pointer in 6-ton skips. Production is rated at 4,000 tons a day. Like the ore from the pits, production from the mine is hauled by rail to McGill.

Underground equipment for the Minnesota Hi-Ore and, later, for Deep Ruth includes nine 10-ton trolley-type electric locomotives and 4-ton side-dump cars. A 100,000-c.f.m. ventilating fan is installed in Deep Ruth. Additional ventilation will be provided later as required.

According to present plans, the main underground operation will be the Deep Ruth, beginning in 1957. Surface structures at the Deep Ruth shaft include a 155-ft. steel headframe; steel ore and waste bins; electric substations; hoist building for housing ore and man hoists, and compressors; saw mill; and change house. Nearly all of these structures, including the headframe, were salvaged from other mine operations.

The hoists have been in service for some time in shaft and station development work. The double-drum ore hoist is equipped with 12-ft. drums and is powered by two 1,650-hp. electric motors. It will lift a 21,000-lb. skip loaded with 12 tons of ore at a speed of 2,500 ft. a minute. The double-drum man hoist with a capacity of 25 men on each deck travels 1,600 ft. a minute. Underground maintenance includes rip track and electric shop for locomotives and cars. Drill repairs will be taken care of in company shops on the surface.

McGILL, NEVADA: At McGill are located the company's concentrator, smelter, electric power plant, limestone quarry, employes' homes, parks, and recreational facilities. The executive offices of the Nevada Mines Division are also at McGill.

CLOSE-UP OF McGILL: The public park area in McGill is in the center of the picture, and the attractive homes of employes are in the foreground. Kennecott employs about 1,200 persons at its McGill operations.

The production at Deep Ruth each day has been calculated at 8,000 tons.

The McGill Concentrator

Upon arrival at the McGill concentrator, which has a capacity of 21,000 tons, the ore is unloaded into an 8-ft. heavy-duty pan conveyor by an electrically powered 80-hp. rotary car dumper. From the conveyor it rumbles into an 84 by 66-in. jaw crusher which has a 250-hp. motor. Secondary reduction is by crushers and ball mills. Recovery of concentrates is by flotation. Lime, which is used in the primary ball mill, is produced in the bleak-peaked backyard of the concentrator.

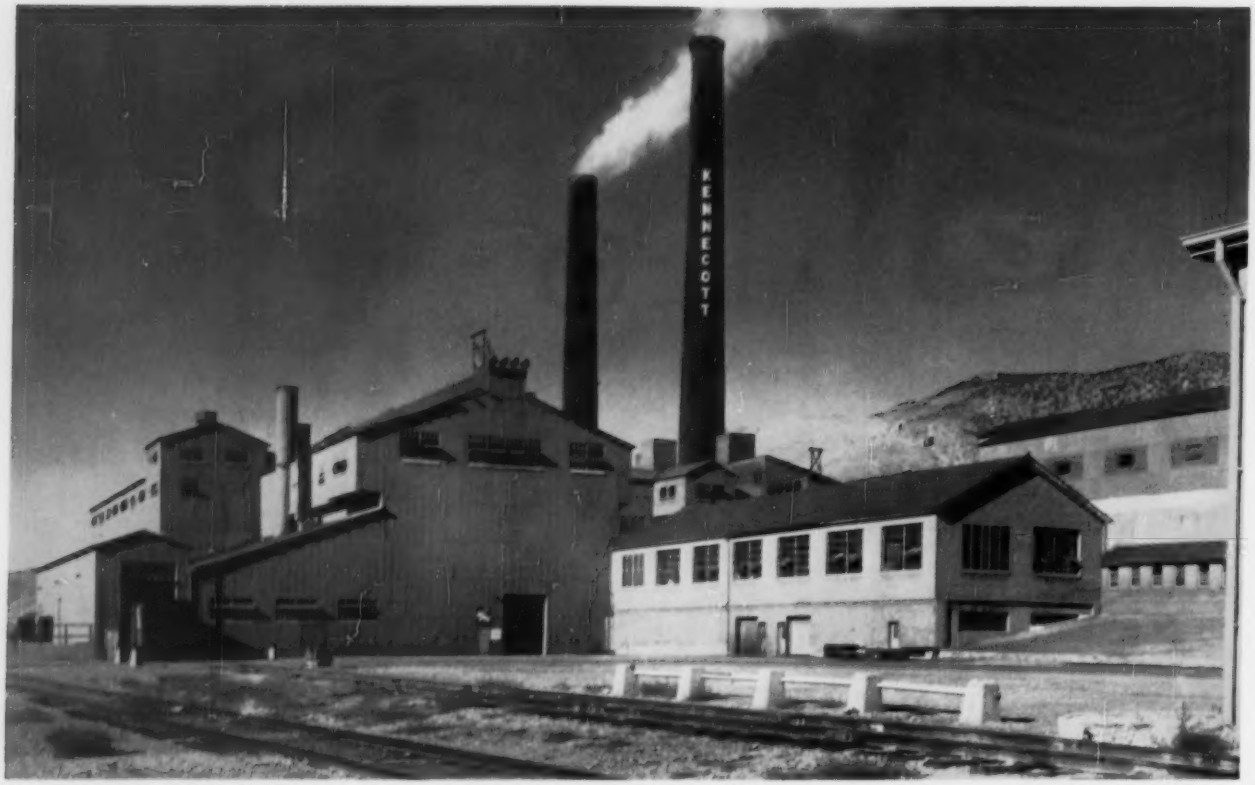
A limestone quarry, located within sight of the plant, produces 150 tons a day. Blasting in the quarry face involves the use of jackhammers to drill vertical holes 1¾ in. in diameter and 18 ft. deep. After springing the drill holes with one to three cartridges of Hercomite powder, they are loaded with charges of Hercomite and fired with Primacord and blasting caps.

Air is supplied with a compressor of 500-c.f.m. capacity. Kilns for treating the limestone are located in the quarry area. Waste from this operation is used as flux in the smelter. The concentrates go directly into the smelter where the blister copper is produced. One of the by-products of the mill is molybdenite.

Located in the vicinity of the concentrator and smelter is the electric power plant, which supplies power to the plant, McGill, the mines, and New Ruth; it also supplies electric power for the municipality of Ely, the commercial center of the group of towns.

Big, Friendly Organization

The Nevada Mines Division of Kennecott Copper Corporation is a big organization with a vast operation that radiates warmth and friendliness, plus a tremendous show of civic pride and cooperation. It handles little problems of life and living with the same dispatch that it finds, mines, and mills copper. About seven years ago, J. C. Kinnear, Jr., general manager of the division, sent Fred Lawrence, chief chemist and research engineer, on a strange mission – to buy tumbleweed seed. Lawrence had a difficult, sometimes an embarrassing, job of convincing people that he was sane and actually wanted to purchase seed of the Russian thistle. Finally, he located a seed-cleaning firm that agreed to accumulate a few sacks of seed for him. At this writing, he seems to be on the

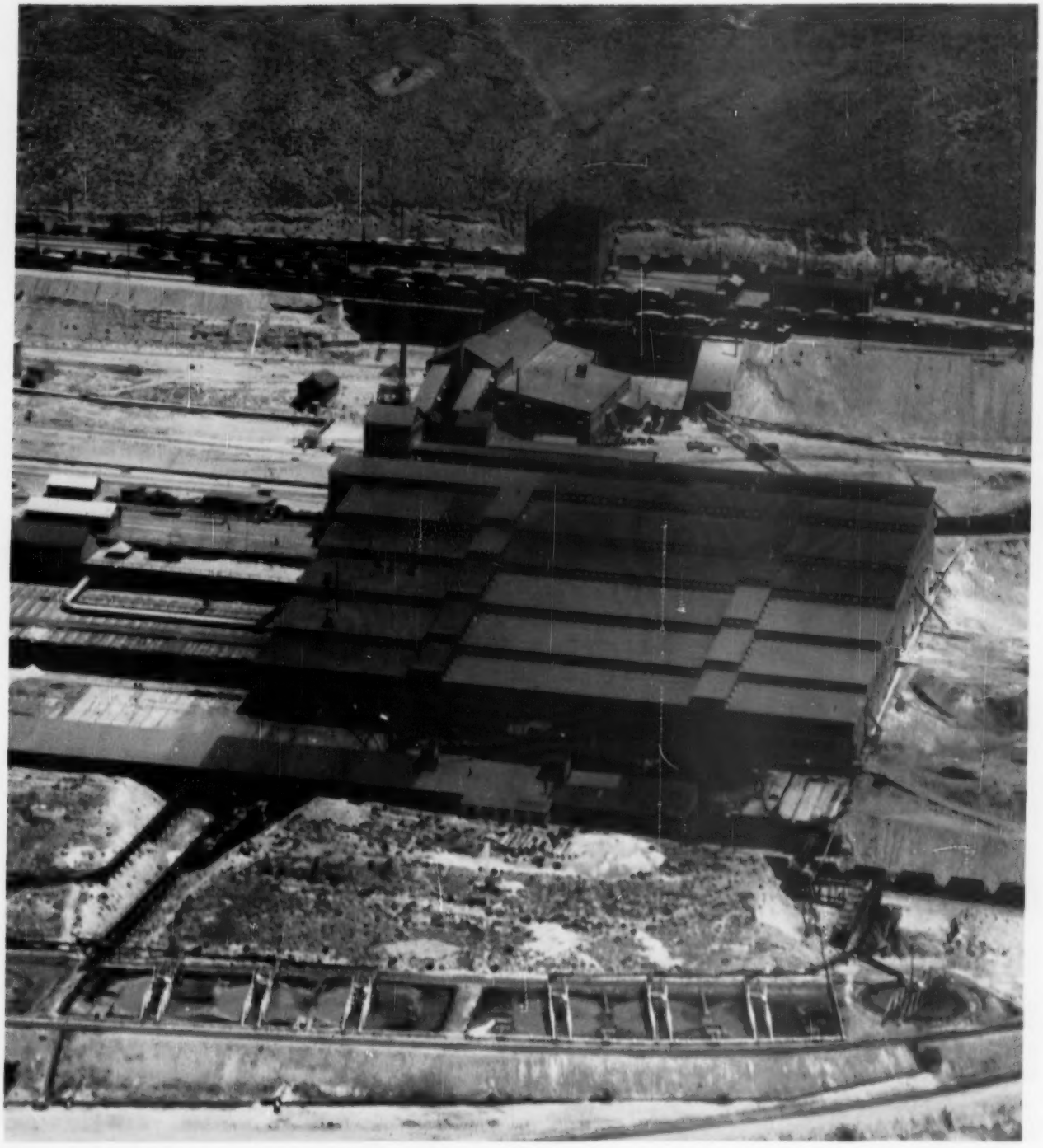


SURFACE STRUCTURES: These modern structures — the smelter, the electric shop, and the repair shop — are maintained in spick-and-span condition. At the smelter, blister copper is produced from the concentrates.

THE CONCENTRATOR: Ore from Kennecott's three open pits and from Consolidated Coppermines' Tripp pit is hauled by rail to the concentrator at McGill. The capacity of the concentrator is 21,000 tons.

verge of making the seed solve the problem that had claimed the attention of Mr. Kinnear — controlling the dust in the 6-sq. mi. tailings pond at McGill. Mr. Kinnear had observed that tumblewood grew better than any other plant on tailings deposits and it was his idea to get vegetation on the pond. Portions of the pond have been planted to these thistles and the vegetation project promises success. This is perhaps the only place in the country where tumbleweeds are being cultivated. Dust from tailings has been a bothersome problem at McGill.

In December, 1954, the Nevada Mines Division established a bimonthly magazine, *Kennevadan*, as a



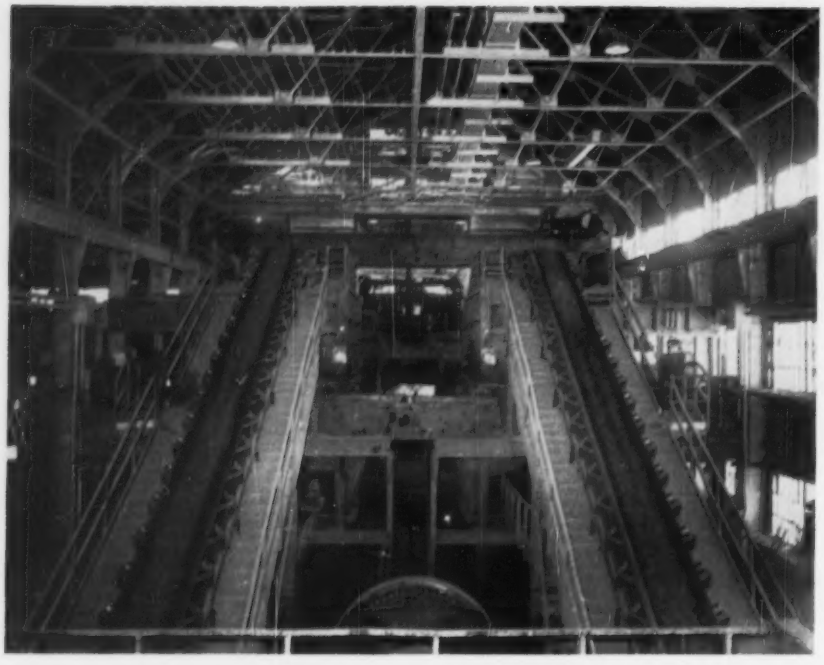
CRUSHING PLANT AND MILL: The crushing plant houses an 84 by 66-in. jaw crusher with a 250-hp. motor. Secondary reduction is by crushers and ball mills. Lime used in the primary ball mill is produced from a quarry within sight of the plant.

means of promoting closer company-employe relations.

McGill is a pleasant village of attractive homes, parks, and recreational facilities; so is New Ruth. The Nevada Mines Division has approximately 2,200 employes: 1,200 at McGill and 1,000 at Ruth. The executive offices of the division are at McGill and the Engineering and Mining Departments are at Ruth.

Kennecott's Executive Personnel

Home offices of Kennecott Copper Corporation are in New York City. Charles R. Cox is president. Other officers, all in New York, are F. R. Milliken, vice president; L. G. Jenness, vice president, research; James Boyd, vice president, exploration; and E. S. Hann, company treasurer.



BELT CONVEYORS: In the crushing plant at McGill, the ore is transported by No. 1 conveyor belts to the Symons screen bins.

C. D. Michaelson, with headquarters in Salt Lake City, is general manager of the Western Mining Divisions, which include Utah Copper, Chino Mines, Ray Mines, and Nevada Mines.

J. C. Kinnear, Jr., general manager of the Nevada Mines Division, directs the activities of a large and efficient staff. M. J. O'Shaughnessy is assistant general manager of this division. Others in executive and supervisory capacities are S. W. Smith, general superintendent of mines; F. G. Woodruff, general superintendent of reduction plant; K. W. Booker, chief engineer of mining department; and F. A. Lawrence, chief chemist and research engineer.

Passengers flying in airliners over the Steptoe can see the famed Copper Flat (Liberty pit), plumes from the smelter stacks, and the headframe over Deep Ruth. But the pilot cannot tell them the full story that has happened, and is happening, in this historic copper-mining region in Nevada.

MACHINE SHOP: This is the machine shop at McGill, with the engine house and the south end of the smelter in the background. As the sign on the shop indicates, safety is a must at all Kennecott operations.

Transmutation

What fierce unrest; what inner, seething urge
Has torn the earth in Nature's changing plan?
Bright lands are raised above the ocean's surge
Or slowly sink from sight in time's long span.

In cataclysmic fury lavas sweep
In molten blankets over lake and sand;
Chill glaciers form in frigid mass and creep
To cool and build anew a fertile land.

Cold rivers rush from high peaks crowned with snow,
Returning to the seas from whence they came;
Great mountains grind to dust and prairies grow
For tree and vine — new Edens to reframe.

Weak humans in their hurried days of life
Strive not to conquer Nature but to calm
Her raging moods, and use her vagrant strife
For good, perhaps to earn some vict'ry palm.

Man leads wild waters peacefully to fields
Athirst, to flower, field, and growing grain;
He rules to gain the bounty good earth yields
To those who toil within their small domain.

Rich is the man, proud may he be who dreams
And from his dreams sees empires rise. Today
Sees deserts waste; tomorrow brightly gleams
The order brought from earth's strange disarray.

BY CHARLES F. THOMAS

(A tribute to the engineers of the Grand Coulee Dam and to the development of the Columbia Basin.)

UNIQUE BRIDGE CONSTRUCTION ACROSS CONNECTICUT RIVER

Placing concrete foundations in rock under 20 ft. of water called for engineering skill and operating know-how of a high order

GORDON LINBERG*

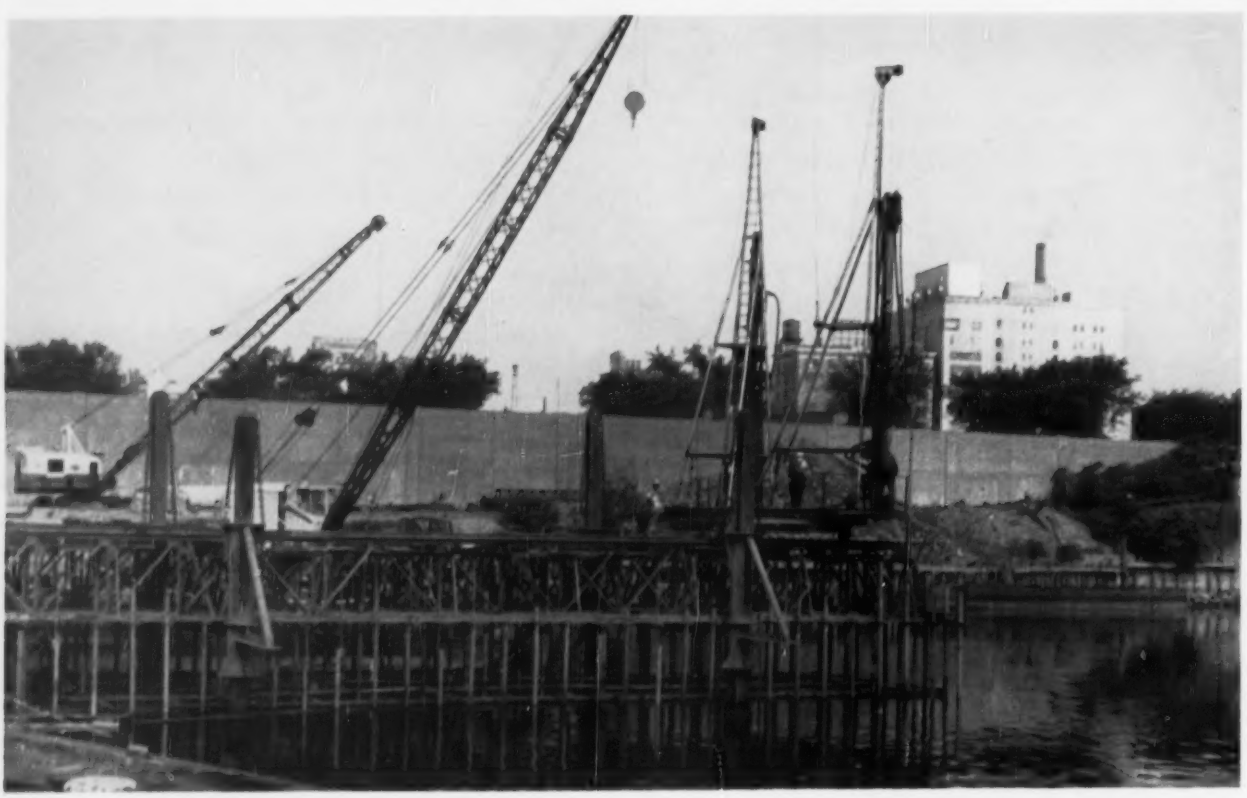
THE construction of a new bridge across the Connecticut River at State Street in Hartford, Connecticut, required the removal of 6 to 10 ft. of rock before tremie concrete could be placed for the installation of two of five river piers. The project is under the sponsorship of the State of Connecticut, with Savin Construction Corporation the prime contractor and Whaling City Dredge & Dock Company the subcontractor, both of East Hartford, Connecticut.

*Engineer, Whaling City Dredge & Dock Company
East Hartford, Connecticut

Pier Five, first of the piers to be installed, is located about 85 ft. from the Hartford, or west, side of the river, with the depth of the water in the stream averaging 20 ft. Overburden consisted of 4 to 6 ft. of mud and silt, then 10 to 12 ft. of clay, and finally 4 to 5 ft. of hardpan. The rock encountered in the river bed was red sandstone, native to this area.

To do this phase of the job, the contractor built a frame of angle trusses that covered the entire pier area. On this trussed frame two rails were mounted to accommodate a carriage on four wheels. On this carriage two T-500 Joy drills with extended masts were mounted. After the pier area had been excavated to the hardpan, the drill frame was floated into position on pontoons. Four 14-in. H-beam spud piles were placed in spud wells fastened to the frame and driven to solid rock. The frame was then hung on

THE DRILL STAND: This drill stand, made of old bridge sections, is supported by four posts with chains, called spuds. Two Joy Challenger drills are mounted on the stand on rails. The series of pipes below the bridge section are forced down through the mud to the rock. Holes for blasting are drilled into the rock through the pipes.



PONTOON FLOAT: Shown here is a pontoon float similar to those developed during World War II. The mounting of the crane at upper left is welded to the deck. It was used to pick up broken rock in the channel and to move the drill stand.

COFFERDAM CONSTRUCTION: Here is a look at the sheeting hammer as it drives down the sheets that make up a cofferdam. In this area, mud on top of the rock measured up to 30 ft. deep. At times, sheeting was driven before mucking began.

these spuds with heavy chains. The carriage and drills were then placed on the frame and drilling of blast holes was ready to begin.

Pipe casings 4 in. in diameter were first jetted into place to form the drill pattern. The tops of the pipes were held by brackets previously welded to the frame. The drills were located to permit drilling two rows of holes as the carriage was moved along the rails by a small air winch. This arrangement made possible the drilling of an average of 28 holes each 16-hour day.

In order to properly handle the required 58-ft. lengths of 2-in. drill steel, a separate frame for each of the two Joy drills was fabricated, each having a 35-ft. mast. The two frames were designed for easy positioning and fastening to the carriage. Carboloy bits 3½ in. in diameter were used. The hole spacing was on 5-ft. centers for the inside holes and on 2½-ft. centers for the outer ring of holes. This made a total of 154 blast holes, with the outer ring of 86 holes drilled 2½ ft. below grade and the center holes 5 ft. below grade. The actual depth in rock was 15 ft. for the inside holes and approximately 12½ ft. for the outside holes. The rock drilled quite well, but was dirty work for the driller. To minimize the blowback of water and mud, a cone-shaped shield hinged to fit around the drill steel was used just above the 4-in. casing. This helped to speed the drilling operation considerably.

*Reg. U.S. Pat. Off.

The Ensign-Bickford Company

Drilling and Blasting

All holes for blasting were drilled before any loading of explosives commenced. The explosives loading procedure involved the screwing together of the required charge of Vibrogel® 3 in Spiralok® cartridges and fusing with reinforced Primacord,* lowering the charge into the casing, and cutting the Primacord to leave 5 ft. of it above the surface of the water. Then pea gravel was poured into each casing to cover the charge. While the drilling was in progress, a floating frame of timbers had been fastened together between rows of casings. To this was fastened each end of Primacord as the casing was pulled, allowing 3 ft. of slack for the rise and fall of the water. Prior to pulling the casing, a light cord

MUCKING OUT: A crane mounted on one of the pontoon floats in the process of mucking out one of the on-shore cofferdams. The wall in background was built some years ago by Savin Construction Company, under the direction of Army Engineers.

was attached to the cut end of the Primacord, and the cord was run over a pulley at the top of the casing. When the casing was clear, a man on the floating frame would cut the cord loose and fasten the Primacord to the floating frame. In some cases, blast holes had to be redrilled as blowing them was found to be ineffective. The loading of the explosives for all of the 154 holes was accomplished in this manner in about 16 hours.

The next operation was to place the pontoons under the drill frame and, after removing the spud piles, drift the frame off the location, leaving the floating timber mat secured with anchors with all Primacord ends attached. When this had been done, the connections were made in the following pattern in order to minimize vibrations from the blast.

Each hole in the outer ring was loaded with 10 lb. of Hercules Vibrogel and each hole in the inner ring with 12½ lb. of this explosives. This added up to a total of about 1,700 lb. of dynamite, or 1.6 lb. per cu. yd. of rock in place.

In the meantime, all floating equipment judged to be too close to the area had been moved. With a set of signals to the crew and the seismograph operators alerted, the blast was fired, using a Hercules 50-cap blasting machine to detonate the charges.

Two other cofferdams in the area were within 65 to 100 ft. of the blast. They were not unwatered, and, with some extra bracing, were considered safe. This proved correct, for neither was damaged from the blast.

Seismograph charts were recorded 600 ft. from the blast area on the Hartford side of the river, where the nearest structures were located. The recordings showed that vibrations from the blast were negligible.

Excellent Results

The results from this method of drilling and blasting were very satisfactory, as both pier locations were excavated with a clamshell bucket to the required lines with no additional blasting. However, in both piers an average overdepth of about 2¼ ft. was excavated before solid ledge was encountered. In the future, in this type of rock, a drilling overdepth of 3 ft. instead of 5 ft. would seem to be sufficient.

Following the excavation, the two cofferdam frames were assembled on pontoons complete with X bracing and welded together. Four spud piles were placed in their wells, the unit floated into place, and the spuds driven into place. The pontoons were then removed by using two floating cranes to lift the frames clear of the pontoons. When the pontoons were clear, the frames were lowered to their working position. The sheeting was stuck around the frame and driven to solid rock. Every fourth sheet was bolted to the top steel frame.

After cleaning the dam of small rock particles and mud with a 14-in. airlift, the blasted area was ready for placement of tremie concrete.

In the case of both piers, the time required for setting up the drill frame, drilling the holes, loading the explosives, removing the frame, and firing the blasts was approximately ten working days.

EXTENSIVE EQUIPMENT: This picture includes some of the extensive equipment used by the contractor on the work of installing piers on the new bridge across the Connecticut River at Hartford. Pontoons floated the equipment to various locations as required.

NEWS NOTES

HYDROGEN SULPHIDE DETECTOR

Development of an improved type hand-operated instrument for the detection of hydrogen sulphide, one of the most toxic industrial gases, has been announced by Mine Safety Appliances Company, Pittsburgh, Pennsylvania.

Principal feature of the new instrument is a dual scale to provide accurate readings in percentages by volume or in grains per hundred cubic feet. Range of the standard instrument is from zero to 25 grains per hundred cubic feet. The percentage graduations on the scale enable use of the instrument for detection of hydrogen sulphide concentrations as low as 0.0025 per cent and up to 0.04 per cent by volume.

Also available is a supersensitive hydrogen sulphide detector with a dual scale arrangement that permits measurement of the gas in ranges from zero to 50 parts per million by volume and from zero to 3 grains per hundred cubic feet.

Both instruments are described in a new bulletin, No. 0805-1. Copies may be obtained without charge from Mine Safety Appliances Company, 201 North Braddock Avenue, Pittsburgh 8, Pennsylvania.

JOY AIRVANE COMPRESSOR

Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pennsylvania, has announced to the construction, quarry, and mining industries a new 600-ft. rotary portable compressor, the Joy Airvane. Modern and functional in appearance, the Joy Airvane is the result of several years of research and field testing.

The new machine contains several Joy developments that contribute substantially to the evolution of the rotary compressor as a practical construction tool. The thermal bypass feature, heart of the Airvane temperature-control system, results in uninterrupted performance and economy, according to the manufacturer. A controlled-velocity filter-separator unit with primary and secondary action removes oil from the compressed air with notable efficiency.

The Joy Airvane rotary is built for rough field usage, the manufacturer states. Exterior housing, of high-strength steel, is weatherproof. Low center of gravity and short turning radius (13 ft.) are combined for easy maneuverability.

For further information, please communicate with the Joy company in Pittsburgh.

DRILLMASTER BULLETIN

Ingersoll-Rand Company is offering a 32-page comprehensive bulletin on its new Drillmaster 6½-in. blast hole drill to quarry operators, road contractors, and construction men. The bulletin covers three types of mountings – crawler, truck, and tractor – and fully explains the revolutionary new "down the hole" drill. Two pages are devoted to very helpful rock job estimating data.

The manufacturer asks that all requests be made on company letterhead and be mailed direct to Ingersoll-Rand Company, Attention: J. K. Uhler, Phillipsburg, New Jersey.

WIRE ROPE FOR DRILLERS

A comprehensive 60-page handbook on the selection, use, and care of wire rope in drilling operations has been prepared by Jones & Laughlin Steel Corporation.

The handbook, titled "Wire Lines for Drillers," covers wire rope applications in oil, gas, and water well-drilling operations. Sections are devoted to using and maintaining wire rope, wire ropes for rotary drilling, wire ropes for cable tool drilling, wire lines for production, and tables of strengths.

The pocket-sized handbook includes numerous drawings comparing the right and wrong ways of using and maintaining J&L wire rope. Also included are diagrammatic drawings of the various types of wire rope.

Copies of the handbook are available from Wire Rope Products Division, Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pennsylvania.

PREVENT CRANE BOOM ACCIDENTS

A positive, automatic safety control which prevents the accidental dropping of the boom on a power crane is now available. According to the manufacturer, the new device makes it possible to regulate and control the unwinding of the boom-operating cable in the lowering of boom loads by the coupling of the drum movement to the engine of the crane. It also eliminates clattering drum rachet noises.

The device can be installed by any mechanic in less than an hour. The complete outfit and license to use may be obtained at a cost of $100.

For more complete information, write to Lee A. Cuson, 507 McKerchey Building, 2631 Woodward Avenue, Detroit 1, Michigan.

WHEEL-TYPE TRENCHLINER

Featuring hydraulic power for raising and lowering the digging wheel, the Parsons Company's new and modern wheel-type Trenchliner is fully described in a 16-page catalog recently published and made available for distribution. A subsidiary of the Koehring Company of Milwaukee, Parsons Company is located in Newton, Iowa.

Photographs and drawings are used in the new catalog to describe the sensitive hydraulic power system developed for the Model 150 Trenchliner for digging wheel control.

TILTING ATTACHMENT ON BULLDOZERS

A new hydraulically actuated bulldozer tilting attachment for use with No. 9S and No. 8S bulldozers has been announced by Caterpillar Tractor Company, Peoria, Illinois.

According to the manufacturer, the new attachment is designed to give D8 and D9 tractors increased versatility on such jobs as ditching, pioneering roads on hillsides, digging rocks, and other applications that require frequent tilting of the blade.

Heart of the new tilting attachment is a large hydraulic cylinder which replaces the left bulldozer blade brace. With the right-hand brace adjusted to its neutral position, either corner of the No. 9S blade can be raised approximately 28 in. above ground level by retracting or extending the tilt cylinder. On the No. 8S, this figure is approximately 24 in.

Additional tilt can be obtained by extending or retracting the screw-type right-hand brace. New bulldozer trunnions, designed to take full advantage of the maximum available tilt, are furnished with all new No. 8S and No. 9S bulldozers.

More complete details may be obtained by communicating with the manufacturer.

KOEHRING TRUCK CRANE

Production of a truck crane version of the recently improved Model 305 excavator has been announced by Koehring Company, Milwaukee, manufacturers of heavy-duty construction equipment. As a crane, it will lift loads up to 25 tons, and its road travel speed is listed at 30.2 m.p.h.

According to company officials, all of the improved operating and maintenance features introduced earlier this year in the 305 crawler excavator have been retained in this truck-mounted model. The upper machinery arrangement has been simplified to contain only two major horizontal shafts. The truck crane turntable swings on six adjustable hook rollers that resist tipping in any direction.

Complete specifications for the 305 truck crane, prices, and other information may be obtained by contacting any distributor of Koehring equipment, or by writing direct to the company at Milwaukee 16, Wisconsin.

VIBRATION TROUBLES?

EXPLOSIVES USERS – If you are experiencing or anticipate legal or public relations problems arising from blasting effects–

Send For Our* BROCHURE *Describing Our Services

(Price Schedule Accompanies Brochure)

Seismograph Protection — Preblast and Postblast Property Inspections

Condition Surveys and Appraisals — Architectural-Structural Services

VIBRATION ENGINEERING COMPANY

301 Hazleton National Bank Bldg. Phone: GLadstone 5-1961 Hazleton, Pa.

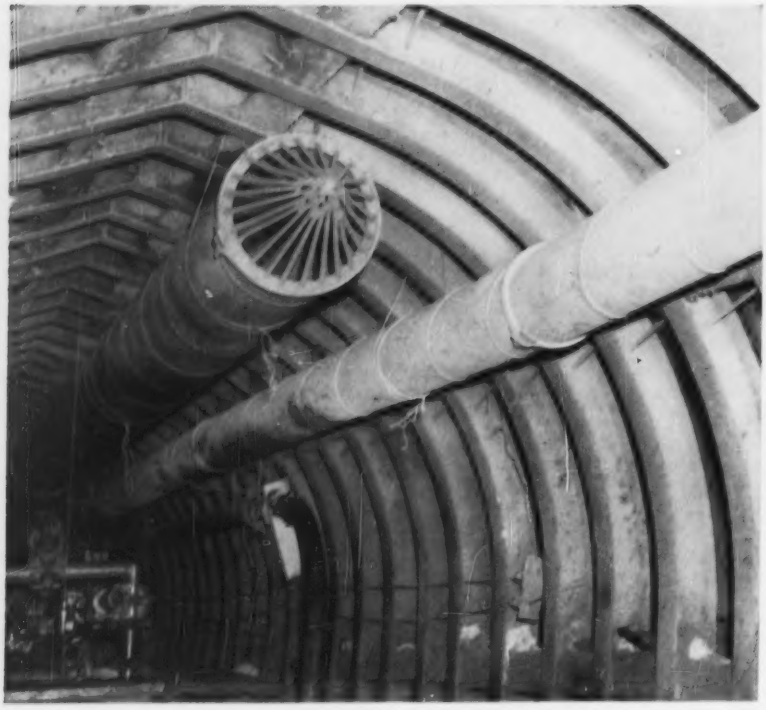
RACEY, MacCALLUM & ASSO., LTD.
5890 Monkland Ave.
Montreal, Que., Canada
Ph: HUnter 9-4941

RANALD E. JONES
1030 S. Main St.
Cheshire, Conn.
Ph: BRowning 2-4806

PHILIP R. BERGER
Bradford Road
Bradfordwoods, Pa.
Ph: WEstmore 5-1655

B. F. Howell, Ph.D., Chief Seismologist

SHORT CUT THAT CUTS COSTS



With the accent on speed in construction work, Naylor pipe has proved a practical help in providing a dependable short cut on ventilating lines.

The combination of this lockseamed, spiralwelded pipe and the one-piece Naylor Wedge-Lock coupling gives you lines that can be installed faster and easier than by other methods. The light weight of the pipe not only speeds the installation but, in addition, the exclusive Naylor structure permits the use of lighter gauge material which reduces costs without sacrificing performance. High salvage and re-use value are other economy factors to consider, too.

For moving air and water and for other materials handling jobs, it will pay you to look into all the advantages offered by Naylor pipe and Naylor Wedge-Lock couplings. Write for Bulletins No. 507 and No. 514.

NAYLOR PIPE

NAYLOR PIPE COMPANY
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from 30 feet to 200 ft per 9½ hr shift

Here at a large eastern limestone quarry, the Ingersoll-Rand Drillmaster shown above is sinking 6" blast holes to a depth of 42 feet, at a rate of 200 ft. per 9½-hour shift. Previously, with other drilling equipment, footage averaged only 30 ft. per shift. The Drillmaster Carset Jackbits are giving 5,000 to 10,000 feet per bit, with 500 feet between sharpenings.

The unique "down the hole" Depth-Master drill, an exclusive Drillmaster feature, goes right down the hole with the bit—avoids power losses in long drill steels and applies the full drilling impact directly to the bit at any depth of hole. The three-way Drillmaster can also be used as a Rotary drill or with the Power-Master "out of the hole" drill when desired.

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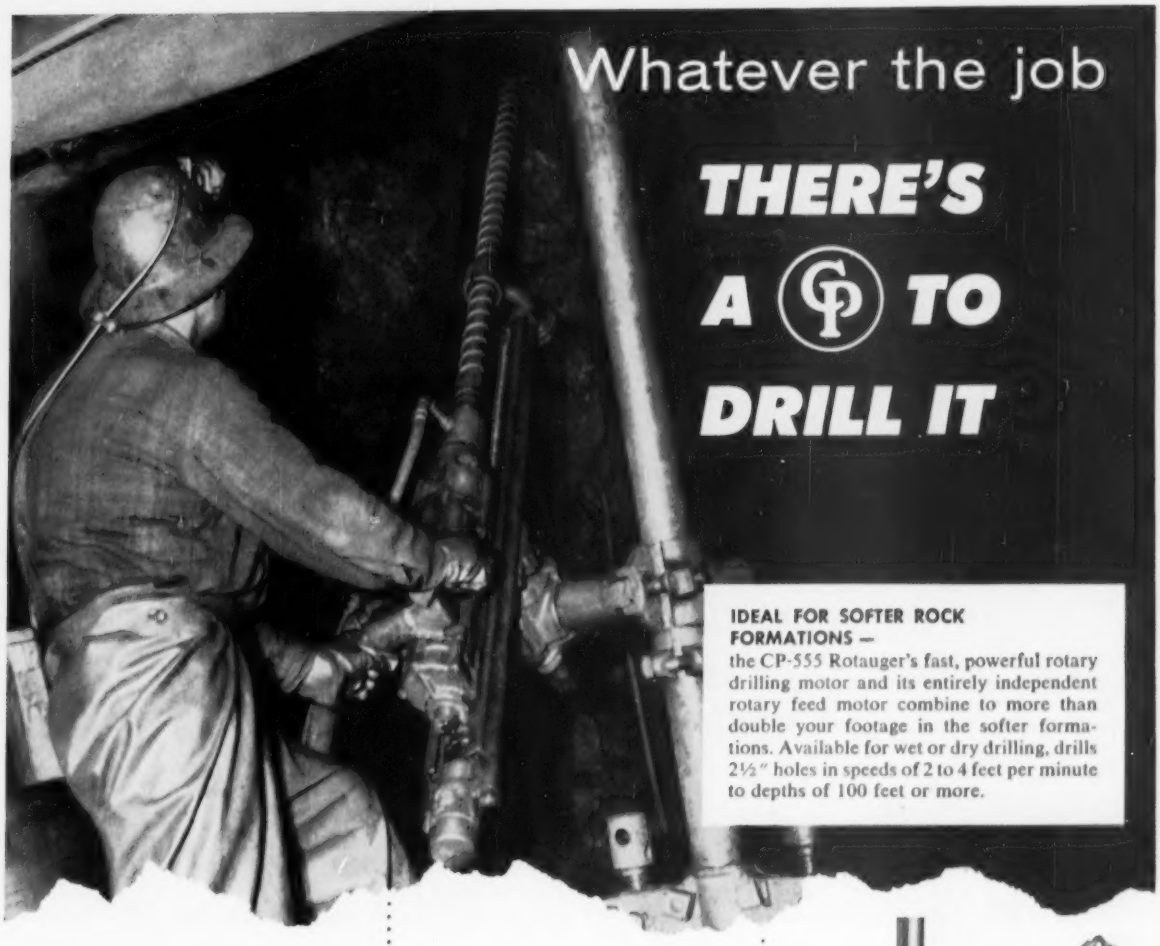

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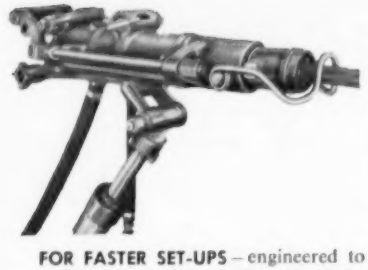
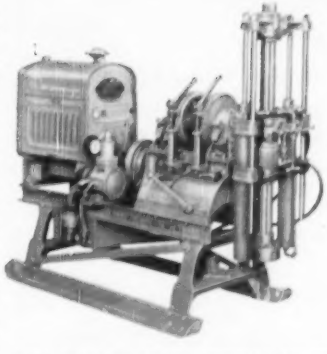
the CP-555 Rotauger's fast, powerful rotary drilling motor and its entirely independent rotary feed motor combine to more than double your footage in the softer formations. Available for wet or dry drilling, drills 2½" holes in speeds of 2 to 4 feet per minute to depths of 100 feet or more.



FOR FASTER SET-UPS – engineered to withstand constant recoil yet hold the drill firmly to the work, the CP Airleg affords the maximum drilling efficiency obtained when using Tungsten-Carbide bits. Available in integral types for production drilling and attachable types for conversion of standard sinkers to airleg operation. And in feed lengths of 36" to 48".



FOR EXPLORATORY DRILLING–CP Diamond Core Drills are available in air, electric, gasoline and Diesel Drives. Capacities to 2250 feet with E-EX Fittings. For skid, column, jeep or truck mounting.

FOR FASTER DRILLING–Designed both for blast hole and exploratory drilling, the air-driven CP-55A Diamond Core Drill has the most powerful vane-type air motor built into a diamond drill. Conservatively rated at 500 feet with E Rods and EX Fittings.

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Unloading a Barge in 3-yard Bites

Oyster shells must travel from Buffalo Bayou through the Houston Ship Channel to reach the site of this Texas cement plant, where they disembark in a hurry.

This 3-yard Marion 101-M, swinging its 70-foot boom at better than a-cycle-per-minute clip throughout the shift, gives the company the big, steady flow of shell it needs. Often, the Marion works around the clock to build up the stockpile.

The Marion 101-M handles as easily as a machine a fraction of its size, thanks to Marion air control. A 12-pound push or pull on the control levers applies full line pressure of 90 pounds to air cylinders that operate the clutches. An independent adjustment lets the operator set the swing clutches to the "feel" that is best for him.

Whatever your job requirement, there is a Marion machine of the right size and type for greatest efficiency

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MARION 43-M	1	*27	*35	—	1–1¼	415
MARION 362	1½	37	—	—	1½–2	398-D
MARION 372	—	43	—	—	—	—
MARION 83-M	2	60	—	—	2–2¼	414
MARION 87-M	—	75	—	—	—	—
MARION 93-M	2½	80	—	—	—	397-E
MARION 101-M	3	84	—	—	—	417
MARION 111-M	4	169	—	—	—	402-B

*Rated at 10' Radius in Accordance with General Practice.

MARION POWER SHOVEL CO.
MARION, OHIO, U. S. A.

Please send me Bulletin 417 on the Marion 101-M.

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THE SQUARE KNOT shown is used *only* to lengthen a *trunk* line of Plain or Reinforced Primacord — *above ground.* It must be drawn up *tight.*

He's tying in another acre of good digging

His holes are laid out in a pattern to obtain the best break-up with respect to the open face, or the most logical direction of the movement of the bank. They're loaded and primed with Primacord, the insensitive detonating fuse. A trunk line of Primacord connects all holes in a planned firing sequence which will promote better fragmentation.

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P-8

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HERCULES OFFSHORE BLASTING AGENT In Heavy-Gauge Steel Containers

It has always been Hercules' aim to provide its customers with the best in modern materials and technical know-how. We believe the development of heavy-gauge steel containers for Vibronite®-B—a nitro carbo nitrate blasting agent—is another example of how continuing evaluation of your needs results in means for improving the efficiency of your operations.

Designed in the Hercules Research Center after careful study of actual offshore requirements, these new, improved steel containers meet all prospecting requirements included in reflection and refraction shooting.

Hercules representatives welcome the opportunity to discuss with you how Vibronite-B packed in these modern containers can assist in your seismic work.

Technical Data

Vibronite-B is packed in distinctive, light blue containers of heavy-gauge steel to withstand transportation, handling, and storage conditions, and to prevent water and moisture penetration. They have a density greater than salt water, which eliminates all possibility of floating charges. These completely new containers are also equipped with large bails and recessed ends to facilitate loading and unloading in the holds of boats, and to provide convenient handling by shooting crews. Hercules Vibronite-B is now available in five container sizes: 8 inches by 50 pounds; 8 inches by 40 pounds; 5½ inches by 25 pounds; 4½ inches by 16⅔ pounds; and 4½ inches by 10 pounds.

HERCULES

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